

now extinct, and similar evidences exist on the Laurentian highlands on the east.

Perhaps the most remarkable feature of the region is that immense series of ridges of drift piled against an escarpment of Laramie and cretaceous rocks, at an elevation of about twenty-five hundred feet, and known as the "Missouri coteau." It is in some places thirty miles broad and a hundred and eighty feet in height above the plain at its foot, and extends north and south for a great distance; being, in fact, the northern extension of those great ridges of drift which have been traced south of the Great Lakes, and through Pennsylvania and New Jersey, and which figure on the geological maps as the edge of the continental glacier,—an explanation obviously inapplicable in those western regions where they attain their greatest development. It is plain that in the north it marks the western limit of the deep water of a glacial sea, which at some periods extended much farther west, perhaps with a greater proportionate depression in going westward, and on which heavy ice from the Laurentian districts on the east was wafted south-westward by the Arctic currents, while lighter ice from the Rocky Mountains was being borne eastward from these mountains by the prevailing westerly winds. We thus have in the west, on a very wide scale, the same phenomena of varying submergence, cold currents, great ice-floes, and local glaciers producing icebergs, to which I have attributed the boulder clay and upper boulder drift of eastern Canada.

A few subsidiary points I may be pardoned for mentioning here. The rival theories of the glacial period are often characterised as those of land glaciation and sea-borne icebergs. But it must be remembered that those who reject the idea of a continental glacier hold to the existence of local glaciers on the high lands more or less extensive during different portions of the great pleistocene submergence. They also believe in the extension of these glaciers seawards and partly water-borne, in the manner so well explained by Mattieu Williams; in the existence of those vast floes and fields of current and tide borne ice whose powers of transport and erosion we now know to be so great; and in a great submergence and re-elevation of the land, bringing all parts of it and all elevations up to five thousand feet successively under the influence of these various agencies, along with those of the ocean currents. They also hold that, at the beginning of the glacial submergence, the land was deeply covered by decomposed rock, similar to that which still exists on the hills of the southern states, and which, as Dr. Hunt has shown, would afford not only earthy debris, but large quantities of boulders ready for transportation by ice.

I would also remark that there has been the greatest possible exaggeration as to the erosive action of land ice. In 1865, after a visit to the Alpine glaciers, I maintained that in these mountains glaciers are relatively protective rather than erosive agencies, and that the detritus which the glacier streams deliver is derived mostly from the atmospherically wasted peaks and cliffs that project above them. Since that time many other observers have maintained like views, and very recently Mr. Davis of Cambridge and Mr. A. Irving have ably treated this subject.<sup>1</sup> Smoothing and striation of rocks are undoubtedly important effects both of land glaciers and heavy sea-borne ice; but the levelling and filling agency of these is much greater than the erosive. As a matter of fact, as Newberry, Hunt, Belt, Spencer, and others have shown, the glacial age has dammed up vast numbers of old channels which it has been left for modern streams partially to excavate.

The till, or boulder clay, has been called a "ground moraine," but there are really no Alpine moraines at all corresponding to it. On the other hand, it is more or less stratified, often rests on soft materials which glaciers would have swept away, sometimes contains marine shells, or passes into marine clays in its horizontal extension, and invariably in its embedded boulders and its paste shows an unoxidised condition which could not have existed if it had been a sub-aërial deposit. When the Canadian till is excavated and exposed to the air, it assumes a brown colour, owing to oxidation of its iron; and many of its stones and boulders break up and disintegrate under the action of air and frost. These are unequivocal signs of a sub-aqueous deposit. Here and there we find associated with it, and especially near the bottom and at the top, indications of powerful water-action, as if of land torrents acting at particular elevations of the land, or heavy surf and ice action on coasts; and the attempts to explain these by glacial streams have been far from successful. A singular objection sometimes raised against the sub-aqueous

origin of the till is its general want of marine remains, but this is by no means universal; and it is well known that coarse conglomerates of all ages are generally destitute of fossils, except in their pebbles; and it is further to be observed that the conditions of an ice-laden sea are not those most favourable for the extension of marine life, and that the period of time covered by the glacial age must have been short compared with that represented by some of the older formations.

This last consideration suggests a question which might afford scope for another address of an hour's duration,—the question how long time has elapsed since the close of the glacial period. Recently the opinion has been gaining ground that the close of the ice age is very recent. Such reasons as the following lead to this conclusion: the amount of atmospheric decay of rocks and of denudation in general, which have occurred since the close of the glacial period, are scarcely appreciable; little erosion of river-valleys or of coast-terraces has occurred. The calculated recession of water-falls and of production of lake-ridges leads to the same conclusion. So do the recent state of bones and shells in the pleistocene deposits, and the perfectly modern facies of their fossils. On such evidence the cessation of the glacial cold and settlement of our continents at their present levels are events which may have occurred not more than six thousand or seven thousand years ago, though such time estimates are proverbially uncertain in geology. This subject also carries with it the greatest of all geological problems, next to that of the origin of life; namely, the origin and early history of man. Such questions cannot be discussed in the closing sentences of an hour's address. I shall only draw from them one practical inference. Since the comparatively short post-glacial and recent periods apparently include the whole of human history, we are but new comers on the earth, and therefore have had little opportunity to solve the great problems which it presents to us. But this is not all. Geology as a science scarcely dates from a century ago. We have reason for surprise in these circumstances that it has learned so much, but for equal surprise that so many persons appear to think it a complete and full-grown science, and that it is entitled to speak with confidence on all the great mysteries of the earth that have been hidden from the generations before us. Such being the newness of man and of his science of the earth, it is not too much to say that humility, hard work in collecting facts, and abstinence from hasty generalisation, should characterise geologists, at least for a few generations to come.

In conclusion, science is light, and light is good; but it must be carried high, else it will fail to enlighten the world. Let us strive to raise it high enough to shine over every obstruction which casts any shadow on the true interests of humanity. Above all, let us hold up the light, and not stand in it ourselves.

#### UNIVERSITY AND EDUCATIONAL INTELLIGENCE

DR. MATTHEW HAY, assistant to the Professor of Materia Medica in the University of Edinburgh, has been appointed to the Chair of Medical Logic and Medical Jurisprudence in the University of Aberdeen, *vice* Prof. Ogston resigned.

THE constitution of the College for North Wales, which is to be established at Bangor, having been approved by the Education Department, arrangements are actively progressing for its opening in January, in order to secure the annual grant of 4000*l.*, which has been offered by Government. As in South Wales, temporary premises will be acquired, and possibly the Masonic Hall, a commodious building lately erected by Major Platt, will be so utilised. Nothing definite is yet arranged as to the site of the College; but it is understood that Lord Penrhyn, who has evinced a very active interest in the movement, and to whom will probably be offered the honour of being first president, will afford every facility to the executive committee. About 30,000*l.* has been promised in subscriptions towards the building fund.

#### SCIENTIFIC SERIALS

*Journal of the Russian Chemical and Physical Society*, vol. xv. fasc. 6.—On the action of halohydric acids upon oxymethylene, by B. Tischenko.—On the constitution of the waters that accompany naphtha and are ejected by mud volcanoes, by A. Potililtzin.—On the formation of bromides of aromatic hydrocarbons by the action of bromine and bromide of aluminium on the volatile parts of naphtha, by G. Gustavson.—On the

<sup>1</sup> *Proc. Bost. Soc. Nat. Hist.* xxii. *Journ. Geol. Soc. Lond.*, Feb., 1883.

formation of tertiary alcohols by the method of Butleroff, by W. Markovnikoff.—On propyl-allyl dimethyl carbinol, by M. Putochin.—On the determination of carbon in cast-iron and steel, by G. Zabudsky.—On the decomposition of orthoclase by putreified matter, by S. Meschersky.—Notes by W. Tikhomiroff and A. Lidoff.—On the application of centres of acceleration of a superior order to the parallelogram of Tchebycheff, by N. Joukovsky.—On the magnetic momentum of bu dles of iron-wire, by P. Bakhmetieff.

*Bulletin de la Société des Naturalistes de Moscou*, 1882, No. 4.—New mints, especially the European ones, by M. Gandoger, being a description (in Latin) of forty-two new species of *Pulegium*, four species of *Prestia*, Opiz., and 135 species of *Mentha*.—On the arrangement of plants for keeping upright, and on the supply of water for exhalation, by V. Meschajeff, being a preliminary account (in German) of researches into the distribution and functions of the so-called mechanical tissue.—On the great comet 1882 II., by Th. Bredichin (in French).—Scientific results of the borings undertaken at Moscow for water supply and canalisation, by H. Trautschold (in German), being the result of twenty-three borings made at Moscow which have pierced the boulder-clay 0.6 to 8 metres thick, or alluvial sands in the valleys; a sheet of eluvium; the four Upper Jurassic layers of green sandstone with *Ammonites fulgens*, *Aucella* deposits with *Aucella mosquensis* and *Ammonites subditus*; black sand with *Ammonites virgatus*, and the usual black Jurassic clay which affords a compact and widely spread layer; a series of red and mottled clays, which may be Permian, underlie the Jurassic deposits and cover the Upper Carboniferous limestone.—Observations on atmospheric electricity at Murom, by N. Zvorykin.—New additions to the kinetic of liquids, by Th. Sludsky (both in Russian).—The European and Asiatic species of *Erirrhinus*, *Notaris*, *Scaris*, and *Dorytomus*, revised by J. Faust (in German).

*Journal de Physique Théorique et Appliquée*, August.—On a gravity barometer, by M. Mascart (three diagrams).—Description of a new form of equatorial telescope and its installation at the Paris Observatory, by M. Loewy (one diagram).—On a synthetic apparatus for producing circular double refraction; on the radiation of silver at the moment of solidification, by M. J. Violle.—The index of refraction of Iceland spar, by M. E. Sarazin.—Selective absorption of solar energy, by Mr. Langley.—On an instrument for correcting gaseous volume, by Mr. A. Vernon-Harcourt.—Change in volume of hydrated salts under the action of heat; the corresponding chemical changes, by M. E. Wiedemann.

*Archives des Sciences Physiques et Naturelles (de Genève)*.—Memoirs on the new registering barometer in the meteorological observatory of Lausanne, by MM. H. Dufour and H. Amstein.—The structure of glaciers, by M. Ed. Hagenbach-Bischoff.—The rheolyser, by M. E. Wartmann.—On the rotation of polarisation of quartz, by MM. G. L. Soret and E. Sarazin.—Observations on cometary refraction, by M. W. Meyer.—On the amount of hail that fell during the storms of August 21, 1881, and July 13, 1888, and some remarks on the history of hail protectors, by M. Ch. Dufour.

## SOCIETIES AND ACADEMIES

### PARIS

**Academy of Sciences**, August 27.—M. Blanchard, president, in the chair.—A telegraphic despatch received by M. Dumas, through M. Pasteur, from the French Cholera Mission in Egypt, announces several important discoveries of a constant character, which will be communicated in detail later on.—New researches on the mode of action of the antiseptics used in stanching sores, by M. Gosselin. From experiments made on rabbits and frogs, it results that phenic acid, camphorated spirits, and similar solutions, are useful in two ways, partly by destroying germs, and thus preventing putrefaction, partly as astringents, by coagulating the albumen of the blood.—On the law of sequence in the evolution of the first vessels in the leaves of the Cruciferae (second part), by M. A. Trécul.—Astrophotographic studies, by M. Ch. V. Zenger.—On the production of the fundamental telluric groups A and B of the solar spectrum by an absorbing layer of oxygen, by M. Egoroff.—Remarks on a foetus which remained fifty-six years in its mother's womb, by M. Sappey.—On some methods for determining the positions of the circumpolar stars, by M. O. Callandreau.—On the measurement of time; a reply to the observations of E. J. Stone, by M. A. Gaillot.—On a formula relative to the velocity of waves; a reply

to M. Gouy, by Lord Rayleigh. In the *Comptes Rendus* for May, 1882, M. Gouy, referring to Lord Rayleigh's correspondence in *NATURE* during the year 1881, recalls a memoir previously published by him in the *Comptes Rendus* for November, 1880, in which occurs the formula

$$U = \frac{dn}{dk} = \frac{\frac{d}{d\lambda} \frac{1}{\lambda}}{\frac{d}{d\lambda} \frac{1}{\lambda}}$$

To this Lord Rayleigh replies that this formula had already been given by him in the first volume of his work on "The Theory of Sound," published in 1877.—Researches on the groups of finite order contained in the group of the homogeneous quadratic substitutions with three variables, by M. L. Autonne.—On the absorption of the ultra-violet rays by the aqueous humours of the eye and by some other substances, by M. J. L. Soret.—On the measurement of the potential differences and resistances between electrodes, by M. G. Cabanellas.—A new method of preparing the oxychloride of phosphorus, by M. E. Dervin.—Researches on the influence of the recurrent nerves on the respiratory movements, and on the modifications of these movements under the influence of anæsthesia, by M. Laffont.—On a falling star observed at Lille on the evening of August 11, by M. Héquet.

### VIENNA

**Imperial Academy of Sciences**, July 5.—T. V. Tanovsky, on amido-azobenzene-parasulphonic acid.—E. Meissl and F. Strohmann, on the formation of fat by hydrocarbons in the animal body.—A. Gehmacher, researches on the influence of the pressure exerted by the bark on the growth and structure of the tree.—L. von Frankl and C. Freund, on the atrophy of skeletal muscles.—E. Auer von Welsbach, on the earths of gadolinite of ytterbium.—T. Kachler and F. V. Spitzer, on oxy-camphor prepared from camphor-bibromide.—T. Wiesner and R. von Wettstein, researches on the laws of growth of vegetable organs.—S. Fuchs, the histogenesis of the cortex cerebri of man.—A. Lustig, the knowledge of the course of nerve-fibres in the spinal cord of man.—F. K. Ginzl, astronomical researches on eclipses (part 1).—E. von Fleischl, on the laws of nerve irritability (part 7): on the irritability of currentless nerves.

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